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Preliminary Assessment of Environmental
Impact of Oil and Gas Exploration 1
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A PRELIMINARY ASSESSMENT OF ENVIRONMENTAL IMPACT

of

OIL AND GAS EXPLORATION

and

PIPELINE OPERATIONS

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PRELIMINARY ASSESSMENT OF
ENVIRONMENTAL IMPACT OF OIL AND GAS EXPLORATION
AND PIPELINE OPERATIONS
IN THE
PROVINCE OF ALBERTA

ENVIRONMENT CONSERVATION AUTHORITY

Underwood McLellan & Associates Limited
Engineering & Planning Consultants
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Edmonton 19, Alberta

June, 1972

ACKNOWLEDGEMENTS

The consultants wish to express sincere appreciation to all of the Government and Industry personnel who so willingly devoted their time for discussions concerning various phases of Oil and Gas Exploration and related activities.

Special thanks are due to members of the Alberta Forest Service who accompanied representatives of the consulting firm during the field studies in the Swan Hills and Rocky Mountain House areas.

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APPENDIX

1. TERMS OF REFERENCE

Identify problems and implications to the environment of oil and gas exploration, pipelines, roads and other oil and gas activities. This is to include assembly of related data and an evaluation of the following:

1. Safety precautions to be taken to eliminate or minimize the effects on the environment. (Erosion control, etc.)

2. Routing of pipelines - feasibility of corridor concept for a group of pipelines and roads.

3. Effects on biological resources, water, timber, wildlife and fish.

4. Present practise of repairing damage - recommendations on any changes deemed necessary.

5. The standards to which access roads should be constructed. Should roads be private or made available to the public for recreation purposes - hunting, fishing.

6. Proposed large diameter oil and gas pipelines. Any special precautions with regard to these lines.

7. Beneficial effects, if any, of oil and gas exploration and production works by opening up areas otherwise unaccessible for recreational uses.

8. Geophysical operations - determine if the multiplicity of seismic cut lines in close proximity can be reduced by co-operative efforts of the companies carrying out exploration work.

9. Erosion - examine area of research on re-forestation of rights-of-way and determine if additional work may be warranted.

2. INTRODUCTION

2.1 Consultants' Procedure of Investigation

The consultants involved in this study have:

1. Obtained and studied the various government acts and regulations pertaining to oil and gas exploration and related activities.
2. Interviewed many senior personnel representing government, the oil and gas industry and other interested organizations on various aspects of environmental impact. (See appendix for a list of personnel with whom meetings were held).
3. Inspected three areas where oil and gas exploration and development has been carried out to observe actual field conditions.
4. Reviewed a variety of literature prepared by government and others dealing with various aspects of environmental impact caused by activities associated with oil and gas exploration and pipeline construction and operation.

2.2 Current Status of Petroleum Exploration and Pipeline Activities in Alberta[1]

The level of petroleum exploration in the province in 1971 was down appreciably from 1970 with a total of 211 crew-months of seismic activity, and 25 crew-months in gravity surveys as well as 984 exploratory wells with a total footage of 4.288 million lin.ft. The comparable figures for 1970 are 347 crew-months, 50 crew-months, 999 wells and 4.543 million lin.ft. In 1967, seismic and gravity surveys in Alberta con-

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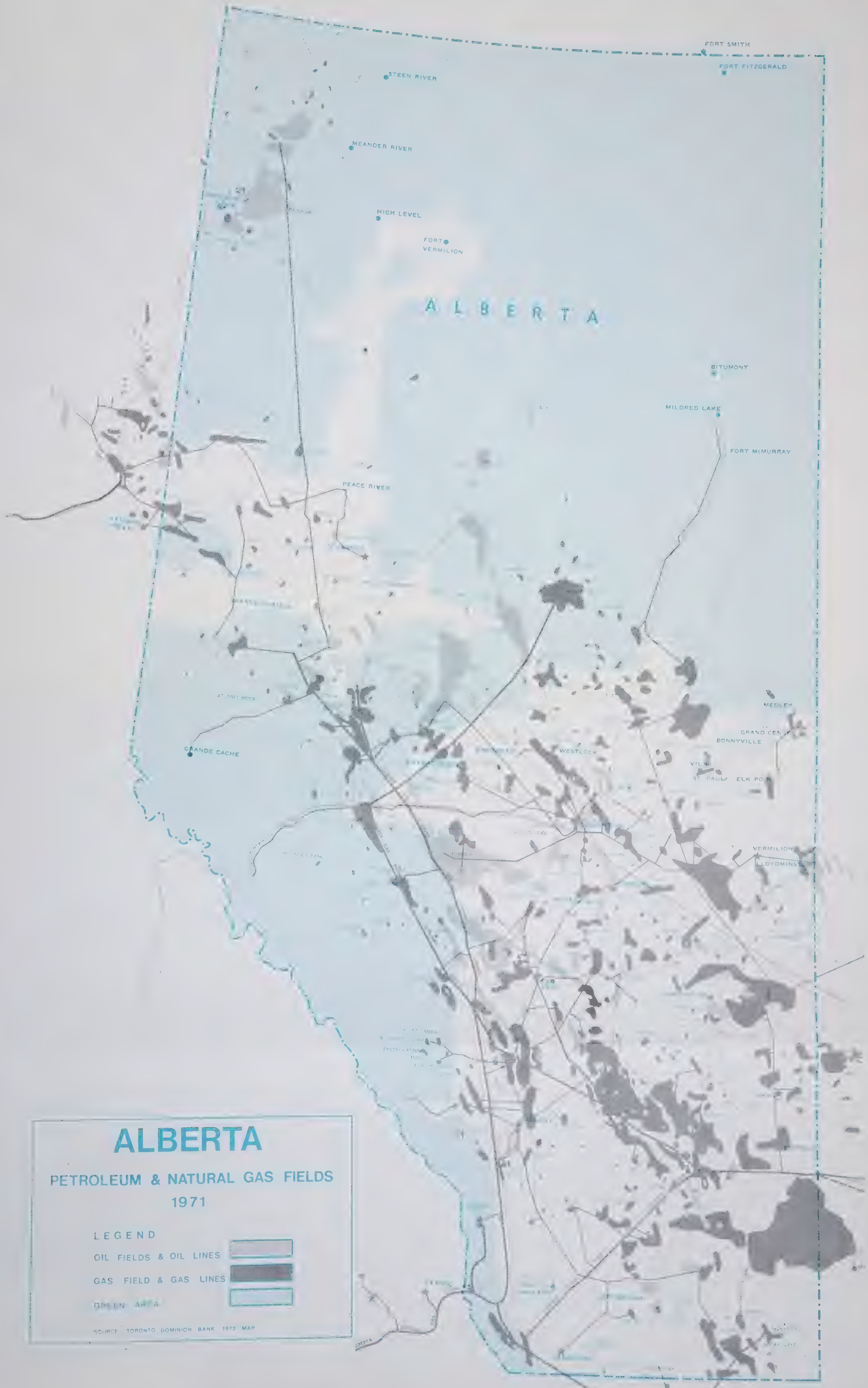
[1] Statistics quoted in this section are generally from "Oilweek", Vol. 23, No. 1, February 21, 1972.



ALBERTA

PETROLEUM & NATURAL GAS FIELDS

1971

SOURCE TORONTO DOMINION BANK 1972 MAP

stituted a total of 636 crew-months. Over the past five years, some 50,000 line miles of seismic lines have been cut in the Green Area of the province. Exploration expenditures for geophysical work and wildcat drilling in 1971 amounted to some $160,000,000.

In land sales, 1971 showed a total revenue to the province from petroleum and natural gas sales of $47,891,000; up approximately $11,000,000 from 1971. This compares with the peak year of 1965 when $141,794,000 was realized from this source. The total acreage placed under permit, gas licence acreages and drilling reservations converted to leaseable acres was 8,288,124 acres.

Some 31,000 miles of pipeline were licenced in Alberta as of March 31, 1971, a net increase of 3,600 miles over 1970. Of this mileage, some 23,000 miles is made up of primary and secondary oil and gas lines.

A total of approximately 17,000 producing oil and gas wells were operating in the province at the end of 1970.

2.3 Accompanying Map

The accompanying map shows the major areas of activity of the Petroleum Industry within the province of Alberta.

Primary concern of this study is with the forested or "Green Area" of the province. This area is shown on the accompanying map.

3. GENERAL DESCRIPTION OF OPERATING PROCEDURES

3.1 Exploration Procedures

The procedures followed by industry and government in petroleum exploration activities are complex. A brief summary description is given in the following paragraphs:

3.1.1 Land Considerations - The acquisition of rights to explore for petroleum and/or natural gas in any specific part of the green area of the province are governed by the following legal requirements:[1]

Surface dispositions on Crown land having reference to petroleum activities are in the form of:

(a) Resource Development Reservations
(b) Mineral Surface Leases
(c) Licences of Occupation

These dispositions are made under the Public Lands Act.

Subsurface dispositions on Crown land having reference to petroleum activities are in the form of:

(a) Crown Petroleum and Natural Gas Reservations
(b) Crown Reserve Drilling Reservations
(c) Crown Petroleum and Natural Gas Permits
(d) Crown Petroleum and Natural Gas Leases
(e) Natural Gas Licences

These dispositions are made under the Mines and Minerals Act.

---

[1] "Analysis of Current Land Allocation", Foothills Resource Allocation Study - Preliminary Report.

Mineral surface leases are issued in connection with removal of minerals and as such are not normally associated with exploration.

Licences of Occupation are normally granted for access roads and may be required in connection with exploration activities.

Petroleum and Natural Gas Reservations, Petroleum and Natural Gas Permits and Crown Reserve Drilling Reservations allow a company to explore the area under reservation in order to establish locations for leases.

In all areas in townships 1 to 64 inclusive and extending from the Saskatchewan border to 114° W. lontitude, entire townships may be in lease. In all other areas, only one-half of any township may be leased with the remainder constituting Crown reserves. The Green Area of the province generally falls within the latter category.

If interest is expressed in Crown reserve land for exploration purposes, a Crown Reserve Drilling Reservation may be issued to permit exploratory drilling. If gas is found and further exploration is desired, a Natural Gas Licence is required. To remove oil and natural gas, a Petroleum and Natural Gas Lease must be obtained. To remove gas only, a Natural Gas Lease must be bought. Lease and licence requirements apply to land held under Petroleum and Natural Gas Permit and Petroleum and Natural Gas Reservation dispositions as well.

3.1.2 Exploration Programs - The exploration phase of petroleum and natural gas development is defined for purposes of this report as consisting primarily of geophysical exploration (mainly seismic) and exploratory drilling. The general procedure in seismic exploration is summarized as follows:

1. A geophysical licence constitutes authority to do geophysical work and is issued under the Geophysical Regulations of the Mines and Minerals Act. It may be issued either to the geophysical contractor or the sponsoring company and is required for all geophysical work.

2. A geophysical permit is required of any geophysical contractor and constitutes authority to operate geophysical equipment in the province.

3. When a petroleum or natural gas reservation is obtained from the Department of Mines and Minerals by a company, exploration can commence, by anyone, with the company owning the reservation having the option to lease up to 50% of the land. The remainder reverts to the Crown and goes up for bid in land sales.

4. All geophysical programs must be submitted to the Department of Lands & Forests for approval. Information must include the program shown on mapping at a scale of 1"=1 mile and must show proposed detours, access roads, airstrips, campsites, etc. Final plans, submitted after the program is complete must be updated to show the final configuration of all work elements.

5. Forestry officials check field programs to ensure minimization of environmental effects as well as maximum re-use of existing lines, roads, campsites, etc. Prior to starting field programs, the contractor is required to check the program with the local Forest Ranger to ensure suitability of the program. Minimum geophysical line spacing in most areas of the province is ¼ mile. Exceptions may be made if supporting geological evidence indicates a necessity for closer spacing or diagonal line cutting.

6. Under the above constraints, the contractor proceeds to clear new lines or re-use old lines and do the seismic testing specified under his contract. Winter operations normally disturb

ground cover much less than summer operations. Seismic vehicles may be wheeled or tracked, with tracked vehicles requiring fewer detours. Maximum line widths are 25 ft. Cleared timber is normally windrowed within the cleared area.

7. Seismic work entails drilling of shot holes and the detonation of explosives in the holes to obtain readings on the seismic instruments. Plugging of these shot holes must be carried out after readings are obtained.

8. Inspection of seismic lines, roads, shot holes, etc. is carried out by various government agencies after program completion to ascertain adequacy of cleanup and to indicate deficiencies requiring repair by the contractor.

Exploration drilling programs have recently come under the control of the Mineral Sales Referral Committee. This committee represents the following government agencies:

Fish and Wildlife Division - Department of Lands & Forests
Forestry Division - Department of Lands & Forests
Energy Resources Conservation Board
Water Resources Division - Department of the Environment

The committee is coordinated by the Interdepartmental Planning Division, Department of the Environment.

Prior to land sale offerings by the Department of Mines and Minerals, the committee assesses the impact of exploratory drilling on the environment and recommends restrictions and/or prohibitions for any specific parcel.

Exploration drilling activities require access roads and drill sites and these are reviewed with the

Local Forest Ranger prior to and during construction. Topography, drainage courses, cleared rights-of-way and location of sumps are considered. Inspection after completion of drilling is made to ensure proper cleanup.

3.2 Pipeline Procedures

Pipeline procedures in Alberta are governed by the Pipeline Act administered by the Department of Mines and Minerals and are further controlled by the Public Lands Act Pipeline Regulations. A brief summary of procedures is as follows:

3.2.1 Land Considerations - A Pipeline Agreement must be obtained under the Public Lands Act to enable a pipeline operator to construct a pipeline and right-of-way installations associated with the pipeline. A Pipeline Installation Lease with a term of 25 years is required of an operator for purposes of constructing surface installations incidental to the pipeline. An operator may apply for immediate entry to lands prior to final execution of the Pipeline Agreement and, if granted, may enter upon lands in the proposed right-of-way for construction purposes.

3.2.2 Pipeline Construction - Under the Pipelines Act, no person is authorized to construct a pipeline without a permit, the application for which must include proposed route, any proposed connection to other pipelines, location and capacity of each proposed installation, and technical specifications. Specification requirements are normally in agreement with C.S.A. Standards on "Oil Pipeline Transportation Systems" and "Gas Transmission and Distribution Systems". Permits are issued by the Minister of Mines and Minerals who may consult the Energy Resources Conservation Board and/or the Gas Utilities Board in reviewing any Permit Application.

Construction procedures in pipelining are dependent on many factors including size of line, type of line and terrain. Normal procedure involves clearing of all timber and brush on rights-of-way and disposal by burning. Pre-grading of certain sections in areas of sharp topographic relief is also common. Distribution of pipe, trenching, pipe assembly, wrapping, placement of the pipe in the trench, backfilling and grading of the right-of-way are other operations involved. Pipeline Regulations require restoration of the right-of-way as nearly as possible to its original condition after construction. Construction is normally required to take place within 12 months after issue of permit.

3.2.3 Pipeline Operations - The Pipeline Act requires that a licence be obtained prior to any operation of a pipeline constructed under a permit. Licence application must include a plan showing surveyed location of the line and disposition of land interests along the line, details of all installations and sizes as well as specifications of the line. Particulars of the testing of a pipeline are also required before operations may commence.

All pipeline breaks must be reported by the operator to the Superintendent of pipelines and must include details of time, quantity of substance lost and any known causes. Any oil pipeline break and approximate quantity of oil spilled, must be reported as soon as possible to the Department of Lands & Forests if the break is in Crown land or a forested area.

4. OPERATIONAL FRAMEWORK

4.1 The Role of Government

It is the role of the Provincial Government to legislate enactments, administer these enactments and to carry out inspections of field operations. It should be stressed that government's role in fulfilling its responsibility to minimize environmental damage is made difficult because of the following conditions:

1. The extent of the area in the province where oil and gas exploration and development may occur, placing a heavy burden on the government to provide supervision and inspection over this large area.

2. The great variety of terrain and climatic conditions encountered in different districts of the province and even wide variations within a particular district. These variations in field conditions make it desirable and even necessary to provide flexibility in government regulations so that the procedure for approval of programs, the supervision of programs and the final inspection can be varied depending on circumstances.

3. The geological conditions favourable for the accumulation of oil and gas vary considerably so that different exploration techniques are required in different fields. Thus, regulations must be flexible to accommodate these varied procedures.

4. The inability of the government, or the petroleum industry for that matter, to forecast accurately the magnitude of oil and gas exploration activities within the province. Thus, the desirable preparation and planning for exploration boom periods is seldom possible. The amount of exploration carried out in any particular year is largely dependent on conditions beyond the control of Alberta, such as,

world and domestic market demands for oil and gas, the availability of risk capital for exploration programs and the state of the internal and external economy.

5. The extreme difficulty of adequately protecting the environment as long as oil and gas exploration is carried out under "hurry hurry" conditions, discussed in a later section.

6. The insufficient investigation of comprehensive land-use planning on a regional scale with respect to high value areas that may be reserved or limited for uses other than petroleum activities. This is currently being remedied, to some extent, through such efforts as the Foothills Resource Allocation Study.[1]

7. In addition to the items enumerated above, the establishment of acceptable exploration procedures is made more complex because of the large number and diversity of disciplines that must be consulted or are directly involved in the legislation, administration and operational aspects of exploration and pipeline programs.

4.2 Acts and Regulations

Government Regulations, concerned with oil and gas exploration and related activities in the province of Alberta, are considered to be satisfactory by most civil servants and industry representatives who were contacted during this study. However, most agreed that there were areas where improvements were warranted and many of those most intimately involved have given much thought to specific changes. The fact that other provinces have drawn generously on the content of Alberta's Statutes for their own use and that foreign governments have eagerly sought advice from the Alberta Government on oil and gas matters, indicates that Alberta's enactments are held in high regard beyond our borders.

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[1] The Foothills Study is a comprehensive investigation of some 10,000 square miles in the southwestern portion of Alberta being carried out jointly by the provincial and federal governments. The purpose of the study is to evaluate and allocate land for its most beneficial use to the various competing requirements.

Some changes in the Regulations pertaining to specific areas have been suggested elsehwere in this report. However, it has also been pointed out that there is a danger of developing too many Regulations and thus eliminating the flexibility which is so necessary in Alberta due to the wide variations in field conditions. Additional and more exacting Regulations would appreciably increase the costs of administration as field inspection staffs would require to be greatly enlarged. It is suggested that better educational programs, as recommended in a later section of this report, together with improved liaison and communication between government and industry are the best courses to follow in order to assure that detrimental effects to the environment are minimized.

There is little doubt, however, that there is an urgent need for consolidation of Acts and Regulations now in force which pertain to activities of the petroleum industry. This would be a substantial, but necessary, undertaking. Most provisions for government control have developed piecemeal over the past quarter of a century and for expediency have been distributed through a great number of government Acts. Such a situation is most confusing to industry personnel as well as to civil servants who are assigned the responsibility for the administration of the Regulations.

4.3 Industry's Position

The petroleum industry is highly competitive and practically all of their activities are conducted with keen rivalry among the industry's members. Oil and gas exploration activities are carried out under extremely competitive conditions because large sums of money are involved, the risks are high but the rewards may be very substantial.

Therefore, traditionally, exploration particularly, has been undertaken on a "hurry hurry" basis and this mode of operation has resulted in high costs to the industry, inconvenience to the government and has frequently resulted in unnecessary damage to the environment.

In spite of the degree of competition in other fields, it is suggested here that there is no need for competition in the area of environmental protection. In fact, it is to the advantage of all petroleum companies to cooperate closely with each other and with the government to minimize environmental damage. The pooling of this knowledge concerning ways and means of reducing environmental damage could result in appreciable economic savings as well as improved performance in the area of environmental impact.

One of the prime concerns of the petroleum industry is that control regulations be applied on the same basis to all companies operating under similar conditions. Some resentment towards the government has occurred in the past because regulations have been different for various fields. However, differences in regulations may be justified based on differences in forest growth, topography, susceptability of an area to accelerated soil erosion and other differences in the terrain of areas.

All petroleum companies have established pollution control departments which operate with various degrees of success. There is a tendency for these departments to be strongly orientated towards control of plant effluents rather than damage to the environment caused by poorly planned and executed exploration and pipeline field programs.

4.4 Liaison and Communication

Minimizing damage to the environment as the result of oil and gas exploration and pipeline operations is dependent on the existence of adequate legislation pertaining to all phases of land acquisition and field operations, good administrative practices and a comprehensive field inspection program. However, unless the liaison and communication among the various government departments involved and between government and industry is functioning satisfactorily; minimizing environmental damage will be difficult to achieve.

The granting of land use privileges and the approval of field program requests are complex, time consuming, expensive but vitally important government responsibilities. The complexity is largely the result of the multiplicity of government divisions that must be consulted by the authorizing agency in order to obtain the necessary facts required to make a responsible decision.

Due to the multiplicity of divisions and the large number of persons involved in the granting of land use acquisitions and program approvals, the Petroleum Industry is also faced with complex, and frequently frustrating situations prior to receiving answers to their requests.

Construction and operating standards are decided, and sometimes adminstered, by a large number of government divisions and therefore good lateral communication within the government and between government and industry is essential if these standards are to satisfactorily serve their purpose.

Another area where close government - industry liaison is a necessity concerns the supervision and inspection of field programs. Here again, there is a multiplicity of government departments and agencies involved which causes confusion and uncertainty and reduces the possibility of attaining minimum environmental damage resulting from oil and gas explorations and related activities.

It is clear that adequate communication, which is essential for good liaison, does not exist among some sections of the government or in some cases between government and industry. Vertical communication within government seems to have developed satisfactorily in most cases, but lateral communication is not as well developed.

The breakdown of communication between government and industry is due largely to the lack of a single spokesman who can speak with authority on behalf of all corporate members of the Petroleum Industry on the one hand; and the lack of an appointed agency who can authoritively speak for all government departments on the other. There are many examples illustrating excellent liaison relations between individual corporations and certain segments of the government because good personal communication has been established over the years. However, these situations, while commendable, do not solve the overall liaison problem that exists between government and industry.

While the liaison problems are many and complex and their solution is beyond the scope of the study, it is evident that the first step necessary for attaining a solution is to improve the government structure and streamline the current liaison procedures.

There is no one government department that has all the necessary expertise on their staff to properly handle the multitude of tasks that must be undertaken with regard to land acquisition, program approval, the setting of construction and operation standards, field supervision and inspection.

The government has been aware of this difficulty and recently steps have been taken to, at least, partially solve the problem, e.g. - the formation of such groups as: the Mineral Sales Referral Committee, the Advisory Committee on Environment, the Inter-Disciplinary Committee on Pollution Control, etc.

However, although progress is being made, a more thorough study of establishing a government structure to deal with the petroleum industry is suggested. The procedures involved in order to develop a more workable structure for liaison with industry would require careful political considerations as well as cooperation among the many government departments and agencies which are at present involved with legislation, administration and inspection of petroleum programs.

It is suggested that there is a need for the establishment of a "Petroleum Agency" which would be given the responsibility of dealing with all requests submitted by members of the Petroleum Industry. The Petroleum Agency would act as a clearing house and would receive, process and provide the necessary documents or authorization for land acquisitions for program approvals.

The formation of a Petroleum Agency would be welcomed by industry and would enable the government to provide better service at less government cost. Maximum use would be made of the wide range of expertise now on the civil service staff and it is not necessary that additional staff would be required.

Each petroleum company should be encouraged or perhaps be required to designate an individual or a group of individuals who would represent the company in dealing with government through the Petroleum Agency.

Better liaison and communication between government and industry is also required during the day to day operations. Field monitoring and inspection of field programs should be clarified and should be assigned to a specific government division. Admittedly, this may be difficult to implement but deserves very careful consideration. The Energy Conservation Board is the logical government agency to provide the petroleum technology that is required in many aspects of supervising and inspecting field programs and operations. However, the Alberta Forest Service has field representatives stationed throughout the Green Area of the province and are well equipped to assume an important role as advisors and inspectors of petroleum field programs. Their knowledge and concern for the protection of the forests, their detailed knowledge of the geography and history of the region, their ready access to transportation and communication facilities, the fact that they are patrolling the forests in the area on a continuing basis and the fact that they are living in or near the area being explored and are therefore quickly available in case of an emergency are facts that must be borne in mind when considering the appointment of field inspectors.

Satisfactory field monitoring and inspection would only be possible if communication and liaison between Forest Service personnel and the appropriate petroleum, technological expertise were well established.

Both government and the petroleum industry have failed to inform the public of the efforts that have and are being made to minimize damage to the environment and of their efforts to restore damaged areas. The government has held conferences and published literature on the causes of excessive erosion and the preventative procedures required to minimize its effect. Regulations concerning field procedures to minimize environmental damage have been established from time to time as additional knowledge becomes available concerning causes of environmental damage. Government and industry have cooperated on a number of programs initiated to prevent future damage restore past damage. Petroleum companies have spent large sums of money to minimize damage and for the restoration of the environment where damage has occurred. Unfortunately, this information, for the most part, has not been communicated to the public.

5. ENVIRONMENTAL IMPACTS OF EXPLORATION ACTIVITIES

The impact on the environment of petroleum exploration activities is directly dependent on the type and extent of exploration as well as the topography, ground cover and wildlife characteristics of the area being explored. A discussion of impacts covering a range of these characteristics is presented in the following paragraphs in order to indicate the diversity of conditions prevailing in the Green Areas of Alberta.

5.1 Forestry

In 1970, the forest area cleared for petroleum exploration activities amounted to some 50,000 acres which roughly equals the area cleared in commercial forestry operations. The majority of this area is for seismic lines, which eventually become reforested naturally, although a change in species of new growth is likely. A high percentage of seismic line clearing, perhaps 50%, is located in areas that do not contain commercial timber.

Timber cut for exploration activities is not usually utilized for wood products as the cleared areas are not concentrated and the recovery of timber is not economic. Also, since much of the timber is damaged during clearing operations, cleared vegetation is usually windrowed or scattered and left to decay. Access roads, well sites and seismic line-road crossings usually require burning of slash.

In summary, impact on forestry is in the loss of timber values where clearing is in commercial stands. Fire hazard from mechanical and human activity may be increased, although access roads and seismic lines improve accessability for fire fighting.

5.2 Watersheds

Impacts on watersheds are generally the result of accelerated erosion caused by exploration activities. Petroleum exploration is not area intensive, but is usually spread over large areas and as such does not have a large effect on major drainage basins. Effects are, however, noticeable on smaller streams and drainage courses in some cases.

Clearing of forested areas can increase runoff amounts and velocities, resulting in larger sediment loads and water volumes entering streams. Disturbance of ground cover in constructing seismic lines, roads and wellsites exposes sediments to sheet and gully erosion by surface runoff. In extreme cases, slopes become unstable, causing massive sediment loads and possible blockage of drainage patterns.

Increasing sediment loads and, in some cases, volumes of water in streams will result in channel cutting, deposition and other changes in the river regime. Possible results include reduction in channel capacity, direction and/or re-location with consequent effects on land areas adjacent to streams and the possibility of flooding. Sedimentation in hydro-electric and water supply reservoirs may also be accelerated with consequent loss in capacity.

Water quality is also affected by increasing sediment loads. This can be an economic penalty to downstream users. Small amounts of chemical and bacteriological pollution can result from human and mechanical activity as well.

In summary, exploration impacts on watersheds are generally associated with introduction of additional sediments to drainage courses with consequent changes in stream regime and water quality.

5.3 Fish

Impacts of exploration activity on fish life are also related to the effects of accelerated erosion almost exclusively.

Changes in environmental conditions of streams or lakes due to accelerated sedimentation can include increases or decreases in velocity, turbidity, depths and water temperatures. Fish species are sensitive to velocity ranges and marked changes in river characteristics due to channel re-routing, stream flows and blockage can force changes in species occupying specific areas.

High sediment loads and bottom deposition reduce oxygen supplies in streams and effects survival of eggs and fry for some species. Spawning beds can be destroyed by deposition. Bottom fauna constituting food sources for fish may also be disturbed by sedimentation.

Erosion of stream banks and removal of tree cover causing loss of shade may change water temperatures as well as the type of vegetation and animal life adjacent to the stream. These elements affect the food source for fish as well as directly changing the physical environment and protective cover in some cases. Trout species are adversly affected by increases in water temperatures.

Increased accessability to streams and lakes resulting from roads and seismic lines may open previously inaccessible areas to more fishermen, thus increasing their use. Management of fish resources in such areas may require readjustment as a result.

In summary, exploration impacts on fish are generally related to changes in the physical environment due to accelerated erosion and changes in drainage patterns.

5.4 Wildlife

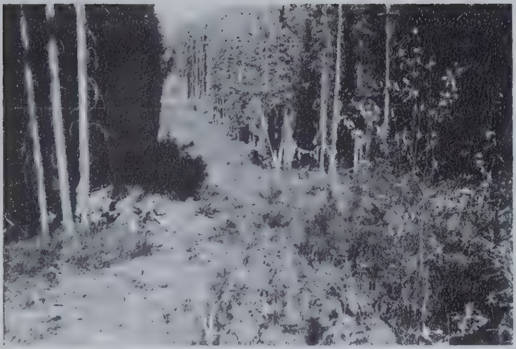
Impacts of exploration activities on wildlife are not intensive in terms of large cleared areas being introduced, but are related to the introduction of access, human activity and continuity of small cleared areas over large areas.

Regrowth on cleared seismic lines is deciduous in the majority of cases and, as such, provides an additional food source for the animal and bird population. The new growth encourages a diversity of animal life and may thereby change the mix and balance of species in a given area. Animals generally use seismic lines as feeding paths rather than migrating paths.

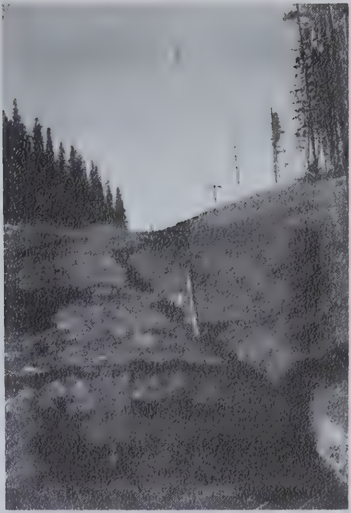
Access roads and new seismic lines provide access opportunities for humans on foot and with various vehicles, thus increasing the exposure of animal life to hunting and other activities. Certain species will move out of areas so affected. Another effect is the increased likelihood of killing of game animals out of season due to the improved accessibility and the presence of human activity in exploration activities themselves.

Exploration activity during nesting periods of game birds may have a disturbing effect on population increase, especially in heavy breeding areas such as Zama Lake.

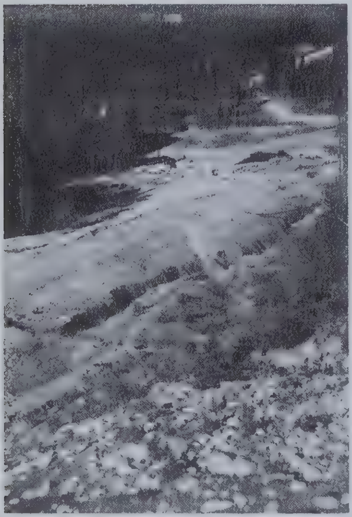
Game management will likely require increased effort in areas with changing species patterns and populations due to clearing and upgraded access possibilities.



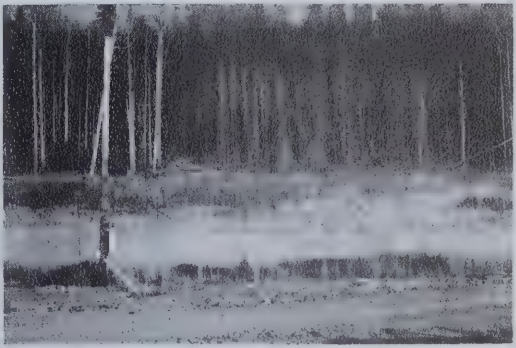
SEISMIC LINE - APPROX. 9 YEARS OLD



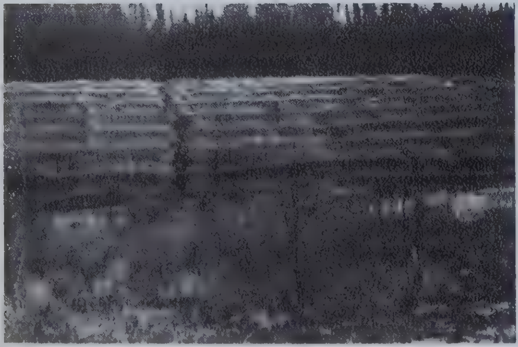
DITCH CHECKS IN SEEDED ROADSIDE



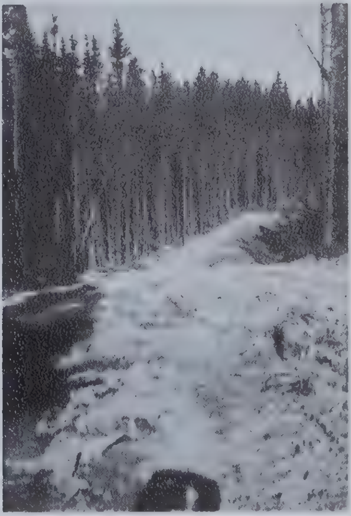
SEVERE EROSION ON ACCESS ROAD



WELLSITE SEEDING



EROSION OF TERRACED FILL SLOPE



PIPELINE R.O.W. AFTER CONST.

EXAMPLES OF EXPLORATION AND PIPELINE IMPACTS.

6. ENVIRONMENTAL IMPACTS OF PIPELINE CONSTRUCTION AND OPERATIONS

6.1 Pipeline Construction

The impacts of pipeline construction on the environment are similar in many instances to those listed in the previous section on exploration activities. These impacts are summarized and related as follows:

Erosional Effects - Clearing of pipeline rights-of-way and access roads has similar effects on watersheds, fish and wildlife as mentioned in Section 5. Forestry effects are not as widespread due to the much smaller mileage of pipelines as compared to seismic lines. Construction activity on the rights-of-way can make these areas extremely susceptible to erosion in regions of severe topographic relief.

Human Activity - Human activity is intensive during construction of pipelines with extensive use of heavy machinery and transportation of men and materials. Wildlife in the immediate area will certainly withdraw during the construction period. Exposure to incidental hunting is also greatly increased during the construction period. Some direct environmental pollution such as garbage, human wastes, mechanical parts, fuels, and lubricants may be imposed on the immediate environment during construction, but do not usually have long term effects. The provision of improved access along rights-of-way will have similar effects on wildlife as those noted in Section 5.

General Effects - Pipeline rights-of-way are normally wider than seismic lines and thereby provide a greater relative growth area for deciduous plants and other animal food sources. Continuing use of the right-of-way for maintenance and inspection as well as recreation tends to keep regrowth down, however, and discourages direct use of the area for habitat by small animal life.

6.2 Pipeline Operations

The operation of pipelines has some general effects on the surrounding area through human activity due to inspection and maintenance as well as aircraft patrol and mechanical equipment operation. These effects are usually minor.

The major consideration of environmental impact in pipeline operations is the effects of line failure and release of the crude oil or natural gas carried in the line to the surrounding area. As an example, there were 212 oil spills reported to the Energy Resources Conservation Board in the first seven months of 1971. While not all of these were due to pipeline breaks, records kept by the Pipeline Division of the Department of Mines and Minerals on oil pipelines show approximately 50 pipeline breaks reported in 1970.

Release of crude oil or oil products to the environment is serious where the fluid enters a drainage course and flows into streams and lakes. Oil covering the water surface obviously excludes normal wave action and over a period of time can reduce oxygen levels in small lakes. Birds, small animals and aquatic life contacting the oil may be disabled or killed. Serious and long lasting effects on vegetation and invertebrates in and adjacent to water courses carrying spilled petroleum may change or destroy the food sources and the general balance of the ecosystems in these areas. This aspect is particularly serious since it is almost impossible to completely clean oil from vegetated areas. Heavy application of petroleum to soils may sterilize an area completely.

Escape of gas from pipelines may have devastating effects on surrounding flora and fauna due to highly toxic nature of the material and the obvious danger of fire and explosion that accompany gas release.

7. WAYS OF MINIMIZING ENVIRONMENT IMPACT

7.1 General

It may not be possible to explore and develop oil and gas reserves in Alberta, based on the present status of known technology, without changing the environment. It is important to note that changing the environment is not synonymous with damaging the environment. Patience is required, however, as nature recovers slowly once its environment has been disturbed, especially if remedial action to restore disturbances is not taken immediately.

In the past, damage to the environment, as the result of oil and gas exploration, has been widespread and in some cases local damage has been intensive. However, it is clear in recent years that both government and industry have recognized past failings and are taking corrective measures to prevent environmental damage as well as embarking on restoration programs.

7.1.1 Environmental Education - Existing programs for the education of government and industry personnel in the causes, effects, prevention and restoration of environmental damage in the industry are not generally set up on a regular and comprehensive basis. Several points are pertinent in this regard:

1. The basic message that avoidance of environmental damage is far preferable to repair of this damage must be transmitted to all levels of personnel involved.

2. The causes and effects of environmental damage are required background in order to obtain a good understanding of the reasons for regulations and for correct field procedures.

3. The problems of industry on one hand and government administration and inspection on the other

must be communicated to all concerned for a proper appreciation of the necessity for specified procedures.

4. The oil and gas industry is highly competitive and therefore many of its activities are carried out in an understandably secretive manner. However, environmental knowledge has had no need to be considered in this light and should be freely shared.

Effective prevention and repair of environmental damage resulting from petroleum activities is to a large extent dependent on successful communication of the above points to industry and government personnel involved. Education programs designed to meet this need are therefore required through the continuance of existing seminars and expansion of a planned educational program to cover all individuals involved.

In spite of sound government regulatory measures, excellent supervision and careful inspection of the completed job; unless all personnel involved in the field work know the correct procedures and are convinced of their effectiveness and necessity, the completed job will be wanting. Best results will be attained when the initiative originates with the individual performing the job so that regulatory measures, supervision and inspection can be minimal.

7.1.2 Environment Inventory and Land Uses - There are two very important reasons why Alberta should obtain, at the earliest date possible, a complete inventory of the renewable and non-renewable resources present in the province: (1) this information is necessary in order to reach a decision on land use before some activity takes place which might invalidate the use of the land for some other more important and more valuable use and (2) the information is required to enable the government to evaluate the environmental damage caused by some activity by being able to compare the present state of the environment with its condition prior to the commencement of the activity.

Included in the inventory would be base line data concerning wildlife such as the number of various species present in the area, the general state of their health, quantitative and qualitative data on water supply, the availability of plant food, description of nesting and spawning areas, as well as inventory of forests and vegetation, soil types, minerals, beaches and other natural recreational facilities. Priority of this inventory survey could be given to high value areas. Having this data available would enable the government to evaluate areas on the basis of their multi-use potential and decide whether or not the area should be thrown open for oil and gas development. Due to a lack of this type of inventory to date, it has not always been possible to make this judgement except in low value areas where the value of the land for other purposes was obviously limited.

Because of the lack of such an inventory, there are many cases where it is impossible to evaluate environmental damage caused by exploration as the true state of the environment prior to exploration is unknown.

The gathering of this inventory would be expensive and would require many years to complete. Furthermore, the data would have to be kept up to date or its value would be quickly lost. Presumably, this could be a joint effort with the Federal Government. Work on compiling this data bank has already started and the Foothills Resource Allocation Study is an example of such a program.

Although time consuming and expensive, it is doubtful if Alberta can afford not to conduct a continuing, long term inventory survey.

7.1.3 The "Hurry Hurry" Philosophy - As has already been pointed out, the "hurry hurry" philosophy is traditionally with the petroleum industry. This philosophy has resulted in opening many of their exploration field programs, such as seismic programs and access road construction in such haste that there is frequently insufficient time for:

1. The petroleum companies to properly plan their field programs.

2. The government to carefully appraise the proposed program prior to granting program approval.

3. The contractors responsible for executing the program to carefully plan the field work so that it can be carried out efficiently without viloating government regulations and environmental safeguards.

4. The contractors to proceed with the work at a pace that is condusive to operating within good construction practice. It is recognized that a workman operating under severe pressure will not perform to the best of his ability.

5. The government field representative to thoroughly inspect the progress of the field work.

While admittedly petroleum companies have always operated on this "hurry hurry" basis regardless of location of the field program, the government of Alberta has not made a determined effort to reduce the pace of field program operations. It is believed that the lengthening of the lead time between the announcement of a land sale and the actual sale would eliminate the necessity for the great rush to complete and assess seismic programs. The argument that the bids for land would be much less if companies had more time to assess the potential of an area has yet to be proved.

7.2 Exploration Activities

7.2.1 Seismic Lines - Minimizing or preventing environmental impact of geophysical exploration is reviewed under a number of subheadings relating to various work elements in the exploration procedure.

Timing - Detrimental effects of seismic line cutting, particularly in high value areas and regions of severe topographic relief, can be reduced by limiting exploration to the winter months only. In winter, clearing operations tend to break vegetation off above ground level without ripping up root systems and causing major disturbance of ground cover. Timing of land sales could be coordinated with this requirement to assure winter programs.

Spacing and Common Usage - The existing minimum spacing of seismic lines in the province is ¼ mile except for certain areas where geological formations require closer spacing (i.e. Rainbow-Zama). Maximum re-use of existing lines is required by the Department of Lands & Forests. Obvious advantages would accrue to increasing spacing of lines and the elimination of continual re-testing of the same ground by many groups. An experiment in the Rainbow-Zama field to carry out seismic exploration and market the information to all interested groups failed due to the lack of agreement among geophysicists as to the type of equipment and results required and the location and direction of lines required for optimum results. The practicality of common information usage and reduction of line spacing has therefore not proven to be practical. Technological advances in equipment could eventually lessen the amount and spacing of work done on the ground.

Types of Vehicles - The type of vehicle used affects the extent of disturbance of ground cover. Field forestry officials indicate a preference for all tracked vehicles as detours are minimized and rutting of seismic lines is reduced.

Use of recreational vehicles on seismic lines after exploration is completed is also a serious consideration in prevention and minimization of damage. Snowmobiles and low ground pressure, all-terrain vehicles apparently do little damage, but 4-wheel drive type wheeled vehicles can damage surface cover extensively. Consideration should be given to prohibiting this type of vehicle from sensitive areas.

Erosion Control and Reforestation - Control of erosion along seismic lines can be optimized by:

(a) Minimizing disturbance of existing ground cover during line clearing and use are discussed above and can be significant aids in prevention of erosion on seismic lines.

(b) Treatment of drainage on long slopes in accordance with procedures set out in "Guides for Controlling Erosion", a booklet prepared by the Department of Lands & Forests.

(c) Careful consideration of stream crossing procedures, with diversions at the stream bank to reduce gradients, crossing on ice during the winter to the largest extent possible, use of culverts rather than earth plugs or logs to cross open water, and prompt removal of any earth placed in streams for crossing purposes. Equipment should not be walked through water courses with soft bottom conditions.

Natural reforestation of seismic lines is usually a long term procedure with the growth of deciduous trees usually occurring in earlier stages. The beneficial effects of this growth and the seismic line openings were discussed previously. Consideration of reforestation identical to that required of timber operators might be applied to seismic lines in forest management areas, although continual re-use of lines over a period of time would delay planting and also make identification of financial responsibilities difficult.

Bonds and Penalties - The posting of bonds as surety against environmental damage requiring repair by exploration contractors is one possible method for ensuring repair work is carried out. The province is currently experimenting with a program whereby each operator using a line is assessed a mileage charge which the government will eventually use for cleanup and repair. This system must assume a certain number of re-uses of any line for fair assessment of charges and could result in insufficient funds being made available for the repair work.

Depending on methods finally adopted for repair and cleanup, the amount of final inspection of lines could vary. At present, government inspection of seismic lines on foot, horseback, by snowmobile, and aircraft is extensive. It is suggested that inspection by examination of aerial photography might be a viable and more economic alternative in some cases.

7.2.2 Access Roads - This discussion on prevention and minimization of impact due to access roads connected with exploration activity can also be applied to roadways developed in the production stages of petroleum activity. The primary effects of access roads are in the areas of accelerated erosion and in the increased accessibility provided. Minimization of impact due to increased accessibility is largely a question of policy regarding public use of roadways and the desirability of any kind of exploration in a specific area. Discussion of access roads, as they relate to accelerated erosion, is the primary concern of this section.

Prevention of Erosion - The prevention of all accelerated erosion would mean practical elimination of all human activity in an area. Presuming that some access roads will be built, certain steps can be taken to prevent erosion.

(a) Reduction of the amount of land to be cleared through careful joint planning with government and industry of any roadway requirements. Current practice in program approval recognizes the necessity of joint planning, but this area warrants additional emphasis.

(b) Careful location of roads, with regard to natural land forms and drainage courses, avoiding large cuts and fills, interference with natural drainage and long grades perpendicular to contours. Improved planning and field supervision of earth moving projects would be of assistance in this regard.

(c) Requirement to submit plans of all stream crossings to the Department of Environment for approval.

(d) Accelerated educational programs on the causes and effects of construction procedures for all levels of staff involved.

(e) The use of adequately sized drainage structures related to probable flows, properly designed ditch checks, and cross-sectional design with adequate ditch capacity in the original design of roadways.

(f) Use of cleared rights-of-way widths in roadway construction that reflect the minimum requirement for the roadway function. Some existing rights-of-way are cleared wider than is actually required.

Restoration and Control of Erosion Damage - At the present time, both industry and government recognize the erosion problem and efforts to develop technology for restoration of eroded areas and minimization of damage on new installations is underway. Ways in which eroded or potential erosion areas can be treated are listed below:

(a) Correction of drainage patterns that have been adversely affected by construction.

(b) Re-vegetation of slopes using local research into suitability of ground cover, mulches, fertilizers, soil types, etc. Establishment of test plots for local conditions is recommended. Use of pulverized slash as a ground cover appears to be a promising approach.

(c) Proper preparation of exposed slopes for re-vegetation through reduction of slope gradients and contouring. The necessity to undertake re-vegetation immediately after construction is emphasized.

(d) Effective supervision of field restoration programs carried out in conjunction with well devised designs for restoration of erosion damage.

7.2.3 Exploratory Drilling - Minimization of impacts on the environment of exploratory drilling is largely related to careful selection of drill sites in relation to topography and surface drainage after it is established that drilling should be allowed in an area.

Drilling sites require areas to be graded to provide room for equipment, material storage, sumps and living accommodations. These locations should be as flexible as possible within the limits of the geological location criteria to insure:

(a) Minimization of forest area cleared,

(b) Minimization of grading, particularly avoiding exposure of large cut or fill slopes,

(c) Separation from any streams such that drainage will not deposit silt or other impurities in the water course,

(d) Location of sumps for drilling fluids and wastes products in areas of good soil stability and proper surface drainage.

The safe disposal of materials left in sumps at the conclusion of drilling is a current requirement as are most of the points listed above. It is essential that these practices be continued and properly supervised. Re-vegetation of all exposed slopes is also considered vital to minimizing the impact of exploratory drilling.

7.3 Pipeline Activities

Government regulations pertaining to pipeline construction and operation are described in the Pipeline Act and the Pipeline Regulations of the Public Lands Act. Design criteria are generally concerned with pipe and flow parameters, with little or no specific criteria relating to the system aspects and possible environmental effects (i.e. valves at main drainage course crossings, etc.). It is recognized, of course that it is in the interest of the operator to ensure a high standard of design to protect his investment. Existing pipeline designs, however, do not appear to regard location related to major rivers or valving in these areas as primary design considerations.

Control systems in all pipeline operations are not presently set up for early detection and location of line breaks.

7.3.1 Automatic Shut-off Valves and Sensing Devises - The subject of installation of automatic shut-off valves at critical points along pipelines should be thoroughly investigated. The placing of automatic valves at both sides of river crossings and at any other points where pipe failure could result in large quantities of oil entering a water system, should be examined. Although the Alberta Oil Spill Contingency Plan is organized to undertake clean-up, the preventation or major reduction of amounts in oil spills is far preferable to clean-up from the environmental standpoint.

Careful consideration should also be given to the use of automatic sensing devices that would immediately alert authorities should an oil spill occur along a pipeline.

Consideration should be given to enactments that would assure proper examination of the condition of installed pipelines as well as continuing maintenance.

7.3.2 Federally Chartered Pipelines - Federally chartered inter-provincial pipelines should meet the minimum Alberta construction standards. Also, the route of these pipelines should be discussed with the appropriate provincial authorities prior to the commencement of construction. It is likely that all presently operated federally chartered, large diameter pipelines meet the minimum standards as undoubtedly these companies have tremendous incentives to operate safely. Not only is their public image at stake, but a break in these large pipelines, unless quickly controlled, could cost them very large sums of money because of product loss. Apparently very little study has been devoted to the routing or standards of large diameter Arctic pipelines that will undoubtedly cross the province at some future date.

7.3.3 Flowlines - Flowlines are normally constructed along the most direct or least expensive route and do not require route location approval. Although it is not suggested that route location approval be required for each flowline, as this would be a very costly undertaking, it is recommended that all flowlines crossing streams and routed where steep slopes exist be reviewed with the government field inspector. As rights-of-way are normally cleared with a bulldozer, serious erosion problems could develop. Field inspectors should have the authority to request a change to the routing of a flowline if the proposed location is likely to cause unnecessary environmental damage.

7.3.4 Pipeline Location - The public is becoming more and more concerned regarding the routing of oil and gas pipelines. It is becoming increasingly more apparent that pipeline route proposals must be given much closer scrutiny than has been the case in the past. Routings require detailed review in high value forested areas and in densely populated urban districts. Pipeline river crossings and pipelines routed adjacent to lakes or rivers also deserve special attention.

It is suggested that a pipeline referral committee be established. The purpose of the proposed committee would be to assess proposed rights-of-way for pipelines with regard to land use and possible environmental damage. This committee would be similar to the Mineral Sales Referral Committee that was formed last spring to assess potential environmental damage of areas to be offered for sale by the Department of Mines and Minerals.

7.3.5 Pipeline Corridors - It is inevitable that the concept of pipeline corridors must become an accepted approach to solving the problems caused by the multiplicity of pipeline rights-of-way that criss-cross many sections of Alberta. Consideration must be given to limiting the amount of land that is being assigned to pipeline

rights-of-way especially in urban areas.
The restrictions placed on land use in these areas. due to randomly located pipelines is seriously interfering with the orderly planning and urban development of the ever growing municipalities. Alberta can no longer afford the luxury of allowing pipeline companies to install pipelines along the most economic routes from the pipeline company's point of view.

Mr. A. E. Gordichuk in a report issued to the Edmonton City Planning Department states that the extra costs to the city are very substantial because of the presence of a multitude of pipelines within its boundaries. The city must bear the cost of casing pipelines beneath new roads, the increased costs due to the necessity of maintaining new roads at a specified height above installed pipelines, extra costs for installation of utility lines in the vicinity of petroleum pipelines, costs of landscaping of pipeline rights-of-way and other increased subdivision costs. The loss of land use due to the building restrictions upon or adjacent to pipelines increases subdivision costs as well as causing great inconvenience to the orderly planning of subdivisions. The consolidation of pipelines into pipeline corridors would reduce costs very appreciably.

Municipal and Provincial Planning Boards should have the jurisdiction over pipeline locations within all areas that may be incorporated into established communities in the foreseeable future. Perhaps this area of jurisdiction should extend at least 5 miles from the boundaries of growing metropolitan areas. Authority should also be granted planning boards to insist on the establishment of corridors within these areas. It is certainly unfair to the heavily burdened municipal tax payer to be responsible for extra costs due to the presence of pipelines while denying the municipality the right to be involved in pipeline location.

A study of pipeline corridor implications is recommended and should include consideration of the following items:

1. Corridor ownership requirements for legal purposes must be established in relation to a number of users.

2. Cost sharing in rights-of-ways with a multiplicity of owners requires a definition formula.

3. Rights and responsibilities of each operator in a joint ownership situation must be resolved.

4. Incorporation of other services and utilities such as highways, railways, electrical transmission lines, etc. must be an early consideration in any corridor concept.

5. The design and safety implications of a number of pipelines, possibly diverse in size and product carried, must be evaluated and general rules regarding spacing, bury, access and special design requirements must be researched and defined.

6. Technical and engineering problems related to construction, operation and maintenance of pipelines within a common corridor, particularly the aspect of equipment working over and around other pipes requires consideration.

7.3.6 Oil Spills - One of the major concerns of the Petroleum Industry, the Provincial Government and the general public is the possible damage to the environment which may occur as the result of an oil spill. Alberta is fortunate in this regard, as pollution control cooperative committees have been established in various producing fields within the province as recommended by the Alberta Oil Spill Emergency Plan. This contingency plan was set up by the Environmental Conservation Committee of the Canadian Petroleum Association in cooperation with the Provincial Government. These pollution control committees have assumed the responsibility of making certain that any oil spills that occur in their respective areas are cleaned up as quickly as possible.

The committees are organized by all the companies operating in the area and a chairman is selected from the staff of the major oil producing company from each area. The first committee was established in the Pembina field and it has become the model of some 20 similar committees throughout Alberta. Both British Columbia and Saskatchewan have adopted similar plans based on the Alberta scheme. Enquiries concerning the plan have been received from many parts of United States and from other foreign countries. Manuals have been prepared containing detailed contour and cultural maps of the districts, complete inventories and location of equipment and supplies required for clean up operations, communication procedures to be followed depending on the size and nature of the spill, telephone numbers and addresses of all government and company personnel that might be involved in a spill and a description and location of oil spill control points throughout the area.

While the basic concepts of the Alberta Oil Spill Emergency Plan are excellent, the plan has not been implemented in all districts to the same extent as has been the case in the Pembina field. Furthermore, there are practically no plans to control oil spills along hundreds of miles of pipelines which do not lie within designated Emergency Plan Areas; either by the government or industry. The government should take immediate steps to remedy this situation by requesting the petroleum and pipeline companies to: a) Insist that all producing areas establish Oil Spill Emergency Pland comparable or better than those now existing in the Pembina field, b) Operation of pipelines be curtailed until the pipeline owners have set up oil spill emergency plans to deal with any oil spill that may occur throughout the length of their pipeline.

Special attention should be given to ready access throughout the year to designated control points along river or stream courses for all supplies and equipment required for oil recovery. Access to river water level at all pipeline river crossings is also important so that repairs of pipeline failure can be quickly completed.

Oil spills are caused by equipment failure, human operating errors and actions from outside the industry including vandalism and even sabotage. It is doubtful if oil spills can be entirely eliminated so that good oil spill cleanup programs are essential.

All oil spills should be reported to one government agency regardless of its source or the magnitude of the spill. It is most important that the Energy Resources Board and the Department of Lands and Forests continue to be involved with oil spills, the former because of its petroleum technological knowledge and the latter because of the availability of widely distributed field personnel and its ready access to communication and transportation facilities.

8. SUMMARY OF CONCLUSIONS

The following general conclusions have been reached as a result of this study:

1. It is not possible to undertake oil and gas exploration programs, especially within the Green Area of the province, without disturbing the land's surface and causing some short term environmental damage. However, through cooperation between government and industry, the damage can be minimal.

2. There is ample evidence that the Provincial Government and the Petroleum Industry are well aware of the impact on the environment caused by the Petroleum Industry's activities and are concerned with finding solutions.

3. Cooperation between government and industry, in working out equitable solutions to the many complex problems which have arisen regarding petroleum exploration activities, has generally been excellent although communication and liaison with each other could be improved.

4. The Provincial Government and the Petroleum Industry are actively engaged in programs to minimize damage to the environment caused by exploration for oil and gas.

5. Both government and industry have failed to acquaint the public or each other with the extent of their efforts to minimize environmental damage.

6. Pipelines that are constructed and operated under federal charters are not subject to provincial legislation.

7. The current timing constraints involving land sales that dictate "hurry hurry" approaches to seismic operations are responsible for unnecessary

environmental damage because there is frequently a lack of time available for proper planning, program assessment and the executing and inspection of field programs.

8. Government and industry are most cognizant of the potential damage which might be caused by oil spills and are cooperating in the cleanup of any oil spill occurrence. However, potential hazards exist which could cause major damage and corrective measures should be taken.

9. There is a lack of adequate regulations concerning valve installation at key locations and the use of sensing devices to protect the environment from possible damage caused by oil spillage along pipelines.

10. While the Oil Spill Contingency Plan is operating most successfully in some areas, the planning to take care of major spills in many parts of the province is not satisfactory.

11. Flow lines do not belong in the same category as other pipelines due to their small diameter and temporary nature and therefore regulations concerning routing, construction standards and inspection practices pertaining to flow lines cannot be the same as those for other pipelines and generally are not covered by most government regulations.

12. The ever growing, intricate network of petroleum pipelines within and adjacent to developing urban communities in Alberta is seriously interfering with the orderly planning of growth areas. Furthermore, the increasing amount of high value land that is being consumed for pipeline rights-of-way can no longer be justified and therefore consideration of a corridor concept is warranted.

13. Many remote areas in Alberta have become much more accessible as a result of oil and gas activity. This has a long term beneficial effect for the people of Alberta provided that field programs

have been executed following acceptable standards and providing that carefully planned wildlife management programs are established to take care of changes in habitat caused by exploration activities.

9. SUMMARY OF RECOMMENDATIONS

It has been concluded that both government and industry are well aware of the fact that exploration activities may result in environmental damage. It has also been concluded that there has been excellent cooperation between government and industry. However, even though successful solutions have been found to a multitude of problems relating to the impact on the environment as a result of exploration activity, many areas require further attention.

Following is a list of recommendations that warrant consideration:

1. The Provincial Government and the Petroleum Industry should embark on a continuing, coordinated educational program to inform all its employees and those of its contractors of the working procedures that cause environmental damage as well as the preventative measures required to minimize damage.

2. The Provincial Government should consolidate the Acts and Regulations pertaining to oil and gas exploration and related activities as well as to clarify some of the clauses.

3. The Provincial Government should establish a central government agency ("Petroleum Agency") which would act as a clearing house and would be responsible for authorizing all field programs and land acquisitions related to petroleum operations. The proposed agency would have the responsibility of communicating with experts in all government departments concerned with field programs and land acquisitions and would provide petroleum companies with all necessary approvals and clearance documents.

4. It would be most desirable if a specific staff group within each petroleum company were designated to handle all dealings with the proposed government

agency recommended above. The practice of assigning to contractors the responsibility of obtaining clearance and approval documents should be discouraged by both industry and government.

5. All oil spills, regardless of the source or magnitude, should be reported to one government department or agency.

6. Permission to operate a pipeline should be withheld unless the owner has filed plans for cleanup in case of pipeline failure throughout the length of the pipeline and has provided access at pipeline river crossings and control points.

7. Soil surveys should be made by competent soil scientists of any area where accelerated soil erosion is now occuring as a result of exploration activity or of any area where it is suspected that the soils are susceptable to accelerated erosion. This has not always been done to the degree required.

8. The Provincial Government should consider the posting of bonds for field construction programs which would be returned when the project has been completed and inspection has determined that environmental regulations have been adhered to.

9. The Provincial Government should consider scheduling land sales so that seismic work in high land value areas and those areas that are susceptible to accelerated erosion would be conducted in the winter months only.

10. Government and industry should establish procedures whereby it would become unnecessary to conduct field programs, such as seismic surveys, within very restricted time periods, thereby appreciably reducing environmental damage. Land sales should be scheduled accordingly.

11. The Provincial Government and the Petroleum Industry should make much greater efforts to acquaint the public with facts concerning environmental damage

that has been caused by exploration activities as well as the steps that are being taken to minimize future damage and restore the environment where damage has occurred in the past. The beneficial effects of exploration activities should also be publicized. The news media, including television, should be used in supplying the public with these facts.

12. Consideration should be given to ensure that federally chartered pipelines within the borders of Alberta are subjected to Provincial Government scrunity regarding rights-of-way, construction standards and operation procedures. This is believed to be important in view of the fact that it is inevitable that federally chartered, large diameter pipelines from the Arctic will traverse Alberta at some future date.

13. The Provincial Government should investigate the possibility of making greater use of aerial photography and proven photogrammetric techniques for assessing proposed seismic programs, route selection of roads, pipelines, battery sites, etc. and for the inspection of completed projects. It is believed that in some cases this work could be carried out more thoroughly, more efficiently and at less cost if aerial photographs and photogrammetric techniques were employed to a greater extent than is currently practiced.

14. Well site and battery locations should be more carefully assessed prior to approval when these facilities are planned near water courses or on steeply sloping ground. Some modification of regulations concerning the positioning of well sites may be required.

15. The government should require that approval of access road plans, including drainage and erosion control structures to be installed, be obtained where roads are to cross ravines or water courses.

16. Consideration should be given to ammending the Canadian Fisheries Act to include silts and clays deposited in water courses and lakes as pollutant if caused by man-made activities.

17. Consideration should be given to the strict enforcement of the banning of the use of 4-wheel drive vehicles by the general public in areas that are sensitive to accelerated erosion, especially during wet periods of the year.

18. More comprehensive planning by government and industry of access road routes should be undertaken and joint use of these roads should be mandatory unless the reasons for not doing so are overwhelming.

10. AREAS RECOMMENDED FOR FURTHER STUDY

1. A comprehensive research program should be undertaken by government and industry into the causes and control of accelerated erosion which is now occuring in some areas being explored for oil and gas. Emphasis should be placed on prevention rather than restoration for all future programs but there is a definite need for improved restoration techniques for those areas now being subject to accelerated erosion.

2. A research program should be launched on a continuing basis for at least a 3-5 year period to investigate the optimum procedures for re-establishing ground cover for areas that are undergoing accelerated erosion. A series of test plots should be established in each region, where accelerated erosion is occuring, so that a variety of ground cover, mulches, fertilizers, soils and seeding procedures can be researched under the climatic conditions prevailing in the area. The results should be made available to all petroleum companies.

3. The Provincial Government should accelerate and intensify the gathering of meaningful baseline data of the renewable and non-renewable resources of the province. This data is necessary so that the government can:

    1) assign the best possible land use of each area so that the maximum rewards for the use of this land will accrue to the citizens of Alberta and,

    2) properly assess the environmental damage that may be caused by exploration or pipeline activities.

4. A joint study by the government and industry should be made of ways and means to extend and up-grade the Oil Spill Emergency Plan. The planning for

cleaning up oil spills in all producing areas of the Province should be up-graded to the standards now in force in the Pembina field. Furthermore, similar plans should be completed to take care of oil spills at any point along all pipelines in the Province located outside of producing fields. Particular attention should be given to river access by equipment and supplies for the repair of pipeline failures and the recovery of oil spills at control points.

5. A thorough investigation by government and industry should be initiated to determine procedures which would minimize the possibility of major oil spills entering lakes and water courses in the case of pipeline failure. The investigation should include the use of automatic sensing devices, the effectiveness of automatic shut -off valves and improved procedures for inspecting the condition of pipelines. Existing installations as well as proposed installations should be assessed.

6. A comprehensive investigation should be undertaken to determine the technological and economic feasibility of establishing corridors that would contain a number of oil and gas pipelines as well as power transmission lines and communication services. The possibility of including highways and railroads within the same corridor should also be considered. The study should examine the problem from an installation, operating and maintenance point of view and should consider the safety, legal and insurance implications to individual owners. It is considered that this feasibility study is essential prior to the selection of specific corridor locations.

7. A study should be made to investigate the economic feasibility of using timber which is cleared from rights-of-way which is now, in many cases, wasted. Small mobile processing plants might be a partial solution to the problem caused by the wide distribution of the rights-of-way. Some form of subsidy to the forest industry might be worth

considering rather than wasting this resource.

8. Because of the large mileage of flow lines, which are currently unregulated, a study should be undertaken to establish control of the location, construction and operation of flow lines in order to minimize environmental damage.

APPENDICES

MEETINGS HELD

Alberta Fish and Game Association
- Gordon Peel - Past President

Alberta Government
- Energy Resources Conservation Board
  - Lloyd A. Bellows - Asst. Manager Field Operations
  - Vern Jones - Superintendent of Field Operations - Edmonton Area
- Department of the Environment
  - H. W. Thiessen - Director Interdepartmental Planning Division
  - Cooper Drabble - Special Consultant
  - Harvey L. Hogge - Director of Pollution Control Division
  - R. E. Bailey - Director of Water Resource Division
  - B. Boyson - Executive Engineer, Water Rights Branch, Water Resources Division
- Department of Industry
  - Les Collins - Deputy Chairman on Task Force Pipeline Corridors
- Department of Lands and Forests
  - Alberta Forest Service
    - R. G. Steele - Director
    - G. M. Smart - Head Land Use Branch
    - A. J. Facco - Land Use Coordinator
    - W. J. Kammermayer - Geophysical Coordinator
    - J. J. Nowicki - Head Multiple Use Planning
    - E. C. Wyldman - Head Land Use Research
    - Rex Winn - Area Superintendent, Slave Lake
    - Lorne Goff - Fire Control Officer,Slave Lake
    - Ed Johnson - Land Use Specialist, Slave Lake
    - Glen Sloan - Forest Ranger, Slave Lake
    - Fred Sutherland - Area Superintendent - Rocky Mountain House
    - Gerald Stuart - Land Use Officer - Rocky Mountain House
    - Ron Lyle, Forest Ranger, Prairie Creek Area
    - Cliff Henderson, Forrester, Clearwater Forester
  - Fish and Wildlife Division
    - Martin Paetz - Chief Fisheries Biologist
    - B. Kemper - Habitat Biologist
    - D. Neave - Senior Wildlife Biologist
    - E. Scheffler - Chief Wildlife Biologist
- Department of Mines and Minerals
  - Pipeline Division
    - A. L. Berry - Superintendent

Minerals Division
Mike Day - Director
Ray Paradis - Inspector Geophysical Branch
Al Lymer - Inspector Geophysical Branch

Alberta Research Council
Dawson Lindsay - Soils Survey Branch

Amoco Canada
Pat O'Connel - Area Superintendent, Pembina District
Peter Krenkel - Petroleum Engineer, Pembina District

Canadian Wildlife Service
Dr. A. H. Macpherson - Regional Director
Dr. W. E. Stevens - Supervisor Wildlife Research

Century Geophysical Corporation of Canada
H. Evans - President

Edmonton Regional Planning Commission
R. N. Giffen - Director
J. Woodroffe

Gulf Oil Canada Ltd.
J. G. Gainer - Head of Environment Control

Interprovincial Pipeline Company
D. D. Burley
T. L. Kyle

Mobil Oil Canada Ltd.
Lorne Walker - Environment Control Engineer

Oilweek
Les Rowlands - Associated Editor

Shell Canada Ltd.
Martin W. Winning - Chief of Environmental Control

Texaco Canada Ltd.
J. M. Daly - Production Department

University of Alberta
Dr. Stephen Pawluk, Professor of Soil Sciences
P. Paetkau - Post Graduate Student - Biology

GOVERNMENT ENACTMENTS

Acts

Agriculture Act
Coal Mines Regulation Act
Clean Air Act
Clean Water Act
Energy Resources Conservation Act
Environment Act
Environment Conservation Act
Fisheries Act (Federal)
Forests Act (1962 & 1971)
Forests and Prairie Protection Act
Groundwater Control Act
Lands and Forests Act
Mines and Minerals Act 1962
Municipal Affairs Act
Municipal Government Act
Oil and Gas Conservation Act
Pipeline Act
Public Lands Act
Quarries Regulation Act
Surface Reclamation Act
Water Resources Act 1955 & Revisions 1971
Wildlife Act

Regulations

Forest Management Regulations
Forest Protection Regulations
Geophysical Regulations
Mineral Surface Lease Regulations
Oil and Gas Conservation Regulations
Public Lands Pipeline Regulations
Public Lands Surface Reclamation Regulations

FIELD TRIPS

Field Inspection trip to Swan Hills Area.

Field Inspection trip to Rocky Mountain House and Strachan areas.

Visit to Drayton Valley to Investigate Oil Spill Emergency Plan.